Passive guided wave tomography applied to the inspection of pipes

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The maintenance plays a major role in both safety and operation costs. Structural health monitoring (SHM) consists in embedding sensors in a structure - such as pipes for instance - in order to detect defects before a serious fault occurs. Guided elastic waves emitted by a sensor and propagating to another one are often used as the physical way of detecting the defect. From last decades, guided wave tomography imaging emerges as a powerful technique for SHM systems to localize and characterize the defect when it comes to loss of thickness such as corrosion or erosion. However, the implementation of such SHM systems is restricted in many situations by the necessity to store or to harvest the electric energy necessary to emit the waves and also by the intrusiveness of the sensors because of the large number of sensors used to inspect the structure. An interesting possibility is to design a guided wave based SHM system with low intrusiveness thanks to the use of guided wave tomography with undersampled data. Indeed, less sensors are used compared to the optimal number but it is still possible to obtain/reconstruct a satisfactory image of the defect. A promising way to reduce energy consumption and electronic complexity of the system is to work only with receivers/passive sensors of elastic waves. To achieve this goal, the cross-correlation of ambient elastic noise naturally present within the structure can be used to retrieve the response between two sensors without using active (piezoelectric) sources. Passive guided wave tomography based on this concept had been previously developed at CEA LIST in the context of plate-like structures and aircraft applications. More recently, we adapted this technique to the inspection of pipes. Here the technique exploits the ambient noise generated by the fluid circulating in the pipe. In this communication, we demonstrate the potential of passive guided wave tomography for the detection of corrosion in pipes. It is directly applicable for industries such as nuclear, oil & gaz, hydraulic… We describe the technique and present experimental results obtained on representative examples.